Mar 2nd, 4:00 PM

Poster Session

Kentucky Water Resources Research Institute, University of Kentucky

LIMESTONE-BASED MATERIAL FOR ARSENIC REMOVAL FROM DRINKING WATER

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Arsenic in surface water and ground water is of great concern because of potential toxic effects in drinking water supplies. The EPA recommended drinking water standard for arsenic, currently set at 50 parts per billion (ppb), will be lowered to 10 ppb by the year 2006. Current remediation technologies are quite expensive and are designed for large water treatment facilities. Many rural water supplies will be out of compliance when the new lower standards are put into effect. This will place increased socio-economic pressure on rural America, primarily because of the lack of inexpensive point-of-source treatment technology.

Arsenic is readily soluble and transports easily through ground water. Observations of arsenic contamination from mining areas in the Black Hills of South Dakota indicate arsenic is retained by native limestone. Batch tests conducted as a function of time show that over 70% of the arsenic was removed within 2 hrs. Analyses clearly indicate that limestone reduced arsenic concentrations from > 100 ppb to less than 5 ppb. The arsenic removal efficiency of a novel, small scale device with a continuous, fresh exposure of limestone was tested. Arsenic test strips were evaluated for ease of use and for quality Analysis and Quality Control (QA/QC) studies. Water samples with various concentrations were tested before and after the batch experiments in order to evaluate the accuracy of the test strips. These inexpensive tests strips can detect arsenic levels on the spot from 1 ppb to 100 ppb.

NOTES

OPPORTUNISTIC WATER EDUCATION

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Many natural resource and water educators follow the idea that there is a need for more and more new and unique educational events, when, in reality, there is a need to become more opportunistic. Over the past four years, the University of Kentucky Cooperative Extension Service sought out existing events or programs to integrate water education. The Kentucky Forest Leadership Program now has a major water component in its five-day summer program for high school students. Two, three-day water camps were conducted with KY and TN 4-Hers. A three-hour water curriculum was integrated into all 4-H summer camps in 2005. Water education became a major focus of a summer program for minority youth. Water-related topics lead the way in two, week-long teacher workshops that explored land use in central Kentucky. Integration into existing programs has depended on building strong partnerships with other agencies and groups. This team-building has strengthened water education programs, reached new audiences with water education, and kept all partners from being stretched too thin.

NOTES

TEN-YEAR SOLUTE CONCENTRATION PATTERNS IN TWO STREAMS OF CONTRASTING LAND-USE IN WESTERN KENTUCKY AND TENNESSEE

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Over the past 10 years (1995-2005), two streams in western KY and TN, one agricultural (AG), one forested (FS), have been monitored to determine effects of land-use on solute concentrations (Fig. 1). Stream chemistry, stream discharge, precipitation records, and conservative tracer experiments were used to help explain the differences in physicochemical and hydraulic characteristics between the watersheds.

Surface water solute concentrations during base and storm flows within each watershed reflected differing land-uses in that the AG stream showed increases in some solutes while the FS stream showed solute dilution (Fig. 2A, B, C). Conservative tracer experiments indicated that the AG stream had slower water turnover times, shorter water uptake lengths and larger water storage zone sizes than the FS stream. Higher hydraulic retention within the AG transient storage zone (extensive gravel bars) resulted in greater whole-stream solute retention. Increased solute concentrations during storm flow in the AG stream was a result of both increased run-off from fields and 'flushing' of storage zones within the stream. The FS stream had a more porous streambed, less storage and displayed solute dilution during storm flow.

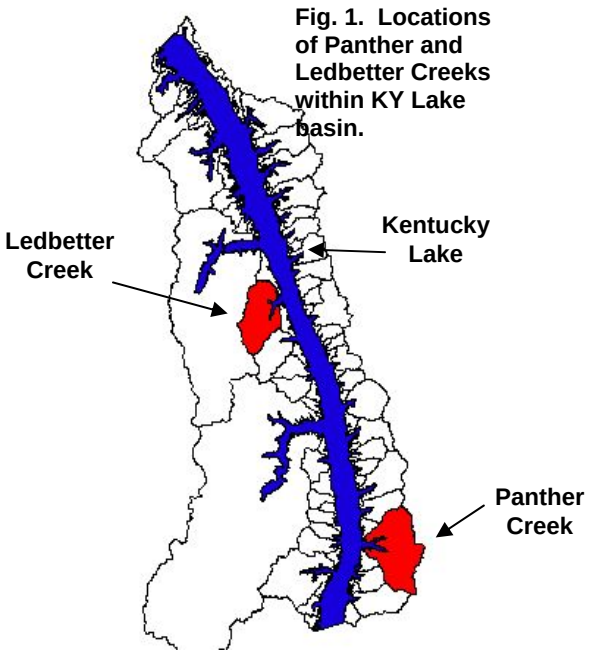

Fig. 1. Locations of Panther and Ledbetter Creeks within KY Lake basin.

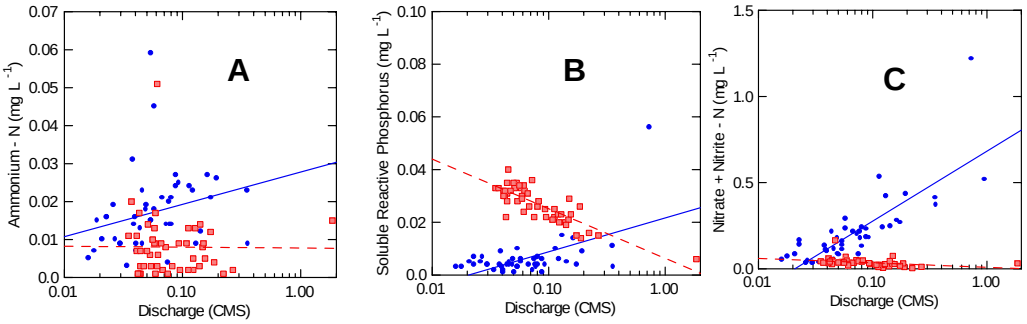

Fig. 2A, B and C represent selected water quality parameters vs. stream discharge at study sites in two watersheds. Best fit regression lines are drawn through data points but statistics are not included. ● = Ledbetter Creek (AG), ▨ = Panther Creek (FS).

NOTES

Pathogen TMDL Development using Load Duration Curves for Two Stream Segments in Rockcastle County, Kentucky

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Section 303(d) of the Clean Water Act requires states to identify waters within their boundaries that have been assessed and are not currently meeting water quality standards for their designated uses. Brush Creek and Crooked Creek, in Rockcastle County Kentucky, were placed on the 1998 303(d) List of Waters for Kentucky for violations of the Primary Contact Recreation standard (KDOW 1998). The suspected sources of pollution in both watersheds are agriculture and onsite wastewater systems (septic tanks and/or straight pipes). The water quality standard for *E. coli* concentrations in recreational waters as stated in 401 KAR 5:031 is 130 colonies per 100 ml as a geometric mean based on not less than five (5) samples taken during a thirty (30) day period or not to exceed 240 colonies per 100 ml in twenty (20) percent or more samples taken in a thirty day period.

Listed waters are prioritized for Total Maximum Daily Load (TMDL) development. A TMDL calculation is performed as follows:

$$TMDL = WLA + LA + MOS$$

Where:
TMDL = the TMDL target, which is defined as the loading that is equivalent to a concentration of 240 colonies/100 ml at a given discharge, in units of billions of colonies per day.
WLA = the Wasteload Allocation, including point sources and Municipal Separate Storm Sewer Systems (MS4s). No point sources exist in these watersheds.
LA = the Load Allocation, including nonpoint sources and natural background.
MOS = the Margin Of Safety, which can be an implicit or explicit additional reduction applied to the WLA, LA or both types of sources that accounts for uncertainties in the data or TMDL calculations.

E. coli results were analyzed using the Load Duration Curve (LDC) method. The LDC is a data analysis tool that plots the load of E. coli observed at a particular sampling station (by multiplying an E.coli concentration with discharge and converting the units to billions of colonies per day {BoC/day}to generate an observed load) versus a curve which represents the maximum allowable load that would be permitted in the creek in similar discharge conditions (by multiplying the Water Quality Criterion of 240 counts/100 ml with a daily average stream discharge value, also converted to BoC/Day). This allows a graphical interpretation of the difference between the existing load and the Water Quality Criterion (Figure 1).

Load duration curves were developed for two sites in Brush Creek and five sites in Crooked Creek using E. coli data collected from May – October 2005. The load duration curve was divided into five flow zones (Figure 1). Each flow zone was assigned a load reduction based on either the 90th percentile of data exceeding the water quality standard, if three or more violations occurred in the given flow zone, or the highest point of exceedance if only one or two data points exceed. Load reductions ranged from 23 – 92 percent of the calculated existing load (Table 1).

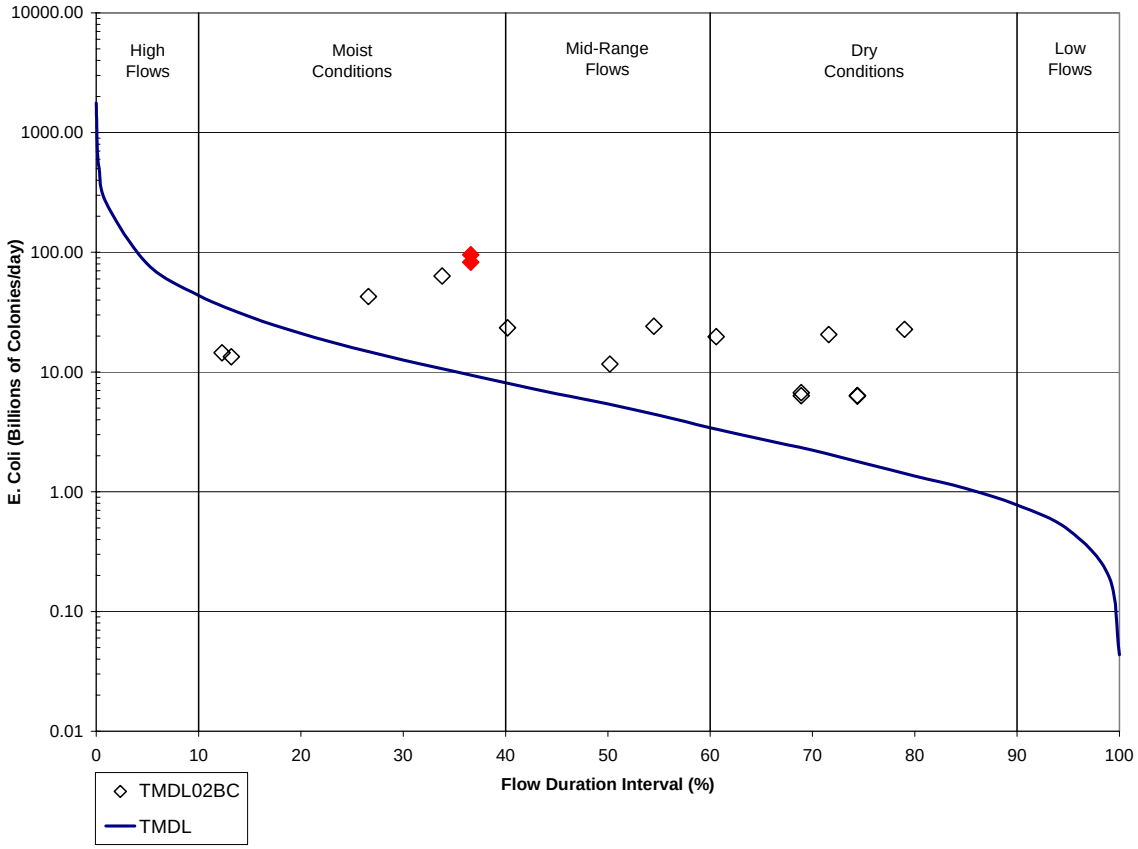

Figure 1 Example TMDL Load Duration Curve.

Table 1 Range of Percent Load Reductions Required by Flow Duration Zones in Brush and Crooked Creek

	High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
Brush Creek	No exceedance	83.86-91.79%	87.10%	96.57%	No exceedance
Crooked Creek	79.11%	90.40-93.35%	23.32-77.87%	23.39-50.47%	No exceedance

BEARGRASS CREEK WATER QUALITY TOOL AND TMDLs

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Problem Statement

Beargrass Creek's three forks drain 61 square miles in the Louisville Metro area into the Ohio River. The Kentucky Department of Environmental Protection (KDEP) has determined that portions of Beargrass Creek do not support the Designated-Use Criteria for Primary Contact Recreation and Aquatic Life due to pathogens, organic enrichment/low dissolved oxygen, and habitat alteration. KDEP has cited a number of suspected sources for these impairments including industrial and municipal point sources, urban runoff, and combined and sanitary sewer overflows.

Beargrass Creek is drained by an extensive system of natural stream segments, open concrete channels, and combined sanitary and storm sewers. The complex hydrology and combination of point and nonpoint sources pose significant technical obstacles for the prediction of water quality.

Development of the Tool

Since 2000, Louisville's Metropolitan Sewer District (MSD) and its consultants have been developing an integrated model system that simulates sewer overflows, non-point source runoff, and stream water quality. This system is called the Beargrass Creek Water Quality Tool. Initially, the Tool was to be used to evaluate CSO abatement measures. Later, Tool objectives were expanded to include the water quality studies needed to support Total Maximum Daily Load (TMDL) allocations in Beargrass Creek. The Kentucky Water Resources Research Institute (KWRRI) joined the project team to oversee development of the Water Quality Tool and to develop pathogen and organic enrichment/low dissolved oxygen TMDLs in Beargrass Creek for the Kentucky Division of Water.

The Water Quality Tool is an integrated system of several computer models that continuously simulate the quality and quantity of runoff, sewer overflows, and stream flows for periods of a year or more. The model, representing 61 square miles, includes 31 subwatersheds, 111 CSO catchments, 39 CSO locations, and 54 SSO inputs.

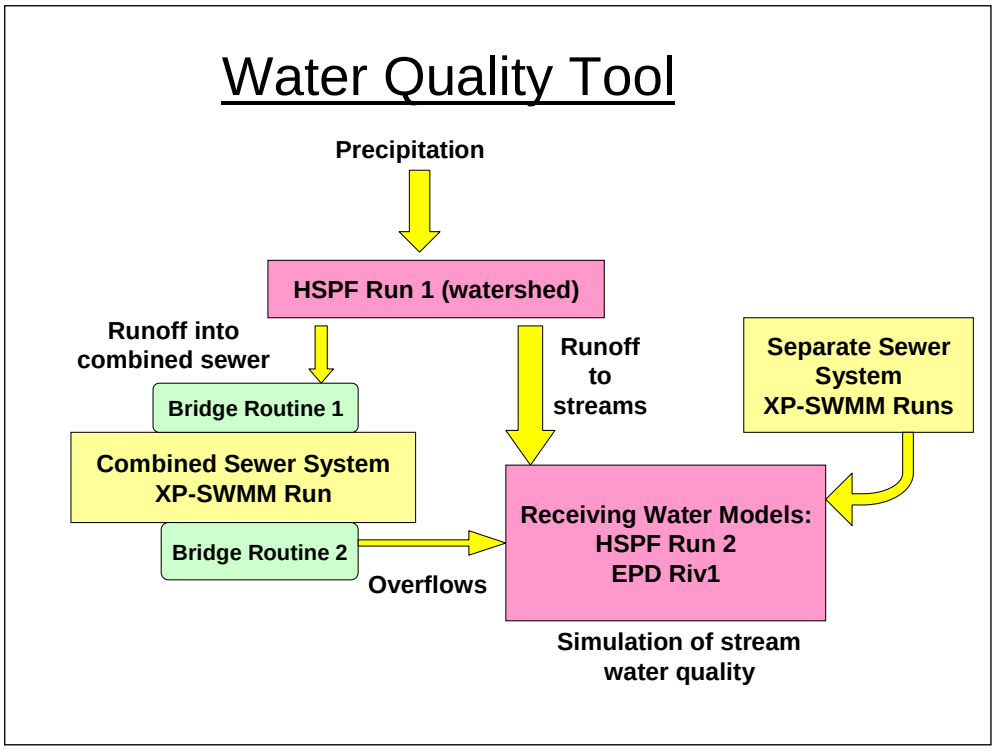
- Hydrological Simulation Program - FORTRAN (HSPF) is used for simulation of watershed loads, in-stream transport, and water quality in Beargrass Creek.

Landuse was quantified based on eight landuse types intersected with three soil types, further divided into pervious and impervious fractions based on effective impervious area estimates.

- XP Software's Storm Water Management Models (XP-SWMM) are used to predict CSO and SSO discharges.
- The CE-QUAL or EPD Riv1 model predicts receiving stream flow and water quality in the lower reaches of Beargrass Creek, near the Ohio River where flow dynamics are more complex.
- Bridge routines convert the formats of large amounts of data from the XP-SWMM and HSPF models to allow the Tool to be an integrated system.

Status

Calibration of the Water Quality Tool is underway at this time. This process begins with the hydrologic and hydraulic simulations, then will extend to water quality load calibration. MSD is planning to collect additional wet-weather monitoring data at selected sewer overflow locations for use in final calibration of the Tool. TMDL load allocations will be developed in mid-2006 for use by KWRRI in developing the TMDLs for pathogens and organic enrichment/low dissolved oxygen for Beargrass Creek. The Tool will be used by MSD in the future for capital projects planning and prioritization.



Pathogen and Sediment Transport in Muddy Creek

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Muddy Creek, a 4th-order tributary of the Kentucky River, lies within an area of changing land use. The stream includes reaches characterized by poor instream habitat, poor channel morphology, poor bank stability, and poor riparian zone conditions. The stream also frequently contains undesirable levels of pathogens, sediment, and/or nutrients, three of the four water-quality concerns most common to streams in Kentucky. Data tracking trends in these parameters document the interactions among humans and land-water systems in the Muddy Creek Watershed, Madison County, Kentucky. The data span four years and are intended to supplement understanding of spatial and temporal trends in Kentucky streams.

From February 2005 to February 2006, water samples from seven sites in the watershed were collected and analyzed by student researchers under faculty supervision. Data were incorporated into a pre-existing database and tied to land-use analyses. Water quality in the stream at times exceeds EPA-recommended limits for total nitrogen and/or total orthophosphate levels, indicating anthropogenic contamination. In addition, stream samples may exceed the reference turbidity level suggested by EPA for Ecoregion 71 streams. Levels of dissolved oxygen are at times lower than the minimum acceptable for warm-water aquatic habitat.

Fecal coliform bacteria in Muddy Creek, indicative of fecal material input, have been collected annually since 2001. Fecal coliform counts ranged from 170 colonies per 100 mL to 18,000 colonies per mL. In Kentucky, water with more than 400 fecal coliform colonies per 100 mL may not be used for swimming; water with more than 1000 colonies per 100 mL may not be used for secondary contact. Higher than acceptable loads of pathogens as indicated by the presence of fecal coliform bacteria may be due to human sewage (failing septic systems or wastewater treatment plants), or local populations of warm-blooded animals. A number of non-point pollution sources exist in the watershed, particularly cattle pastures, which are present throughout the stream. Livestock density is substantially higher in Muddy Creek than in other areas of the Kentucky River basin. Therefore, in addition to annual fecal coliform analyses, monthly samples were collected during the past year and analyzed for total coliform (TC) and atypical coliform (AC). The AC/TC ratio is potentially useful in differentiating between

fecal material associated with animals and human sewage. For much of the period of interest, AC/TC ratios were high (up to 1700 or higher), suggesting predominantly aged material associated with agricultural sources. However, during periods of low flow, AC/TC ratios in Muddy Creek were lower, occasionally less than 2, and within the range associated with human sewage. This is contrary to previously reported findings of AC/TC ratios in the Kentucky River, in which ratios within the range of human sewage were associated with wet periods.

The lowest AC/TC ratios measured in the watershed occurred during low flow months in the Central Kentucky Wildlife Management Area, the headwaters of Muddy Creek and an area expected to demonstrate little, if any, influence from man's activities.

Sediment load, a common problem in Kentucky streams, is of concern in Muddy Creek as well. Turbidity data are increasingly accepted as a surrogate for suspended sediment concentrations in a particular stream when a relationship between the two is shown to exist. During the past year, the stream was sampled during or shortly after rainfall events. Turbidity measurements taken during sampling were compared to measurements of suspended sediment concentration to determine the relationship. Rainfall events during the study period were infrequent and of short duration, and the data collected were not indicative of normal sediment transport; therefore, suspended sediment concentration data continue to be collected. Additionally, as part of this study, the EKU Environmental Research Institute contracted with USGS to install a monitoring station near the mouth of Muddy Creek. The continuously collected turbidity data from the station, coupled with continuing measures of suspended sediment, will ultimately allow turbidity data from the stream to be used as a surrogate for suspended sediment, and will lead to valuable tracking of sediment transport.

WATER QUALITY AND GEOMORPHOLOGICAL CHARACTERIZATION OF FIRST-ORDER STREAMS IN THE EASTERN KENTUCKY COAL FIELD

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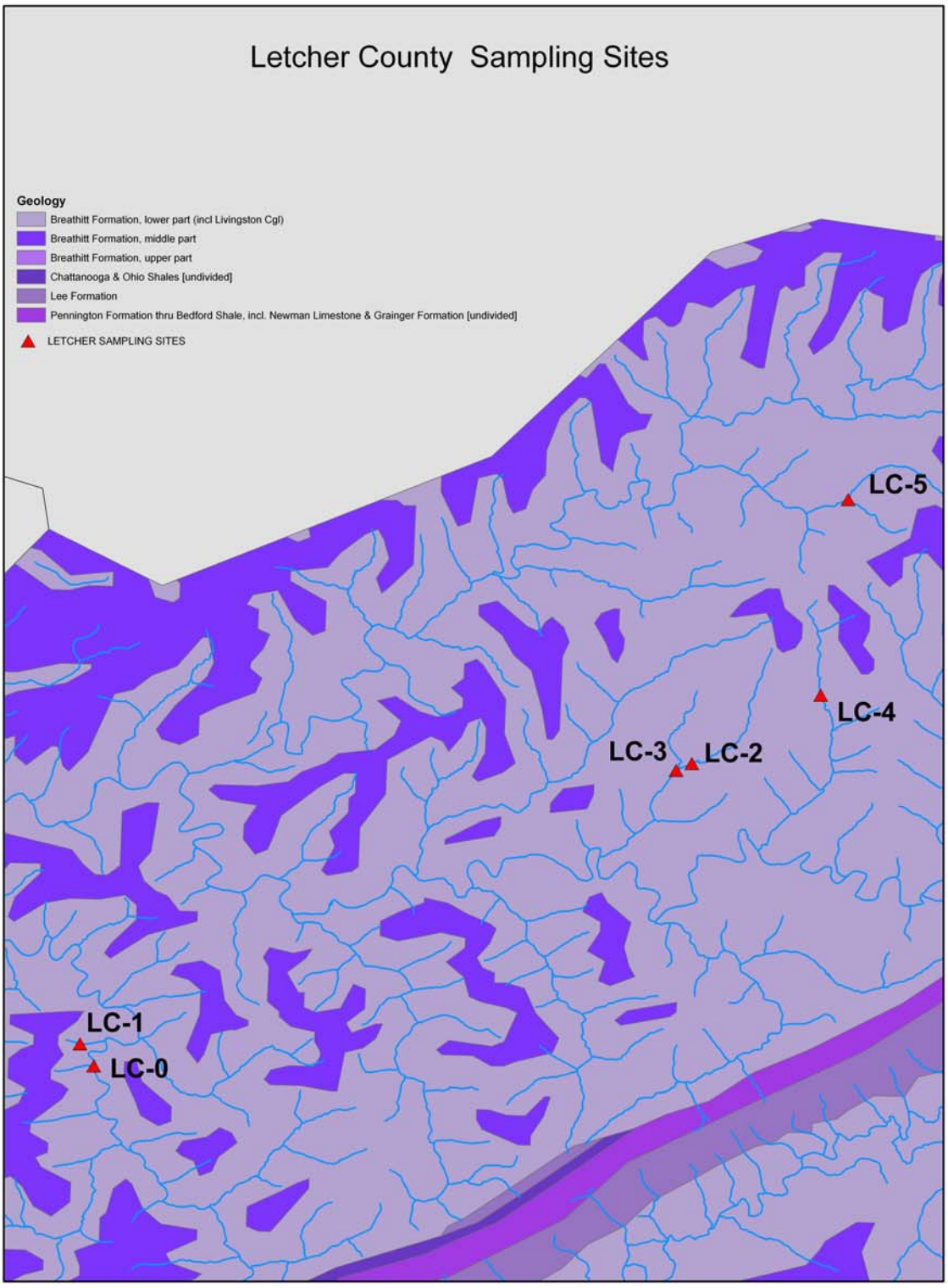
The Eastern Kentucky Coal Field is characterized by steep mountainous terrain and intense coal production. Rocks in the province, mostly sandstone, coal, shale, and thinly-interbedded limestone in this province, are of Pennsylvanian age and have a regional structural dip to the southeast. Over the past 200 years this region has produced almost 6 billion tons of coal, most of which was obtained by surface mining processes that have impacted local streams.

This study compared the water quality and geomorphology of a first-order stream draining a watershed in eastern Kentucky that has been surface-mined, against a reference stream in an adjoining watershed covered by a nearly pristine deciduous forest. The reference stream also provided a baseline against which to compare the water quality of six streams impacted by Acid Mine Drainage (AMD) that exhibit similar geology, order, length, and load.

Methods used to determine geomorphological data included walking the streams to note evidence of deposition, erosion, stream widening, and pooling. Discharge readings were also conducted along with stream channel surveys, which measure stream channel development, pebble counts, and bed load classifications.

Seven sites along the AMD-impacted streams were sampled monthly to determine water quality, including measurements of pH, electrical conductivity, turbidity, dissolved oxygen, hardness, temperature, total acidity, and alkalinity. Funding for site visits and monthly sampling was provided by the Eastern Kentucky Environmental Research Institute.

Preliminary data demonstrate measurable differences between both water quality and geomorphology of the reference stream and that of the comparison streams. The comparison streams exhibited lower pH, higher conductivity, lower alkalinity, and lower level of dissolved oxygen then the reference stream. Preliminary geomorphological data indicate that the reference stream is more stable, based on fewer meanders, fewer areas of erosion or deposition, and less evidence of stream widening.



Map by Michael Albright,
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EXPERIMENTAL STUDY OF THE IMPACT OF UPLAND SEDIMENT SUPPLY UPON COHESIVE STREAMBANK EROSION

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This research project is experimental in nature and studies the in-stream interaction of fluid turbulence, upland sediment supply, and cohesive streambank erosion. Experiments were designed for testing these complex interactions within the controlled setting of the 12 m recirculating flume in the Hydrosystems Laboratory located at the University of Kentucky, Civil Engineering (see Figure 1). This poster presentation illustrates: (1) the experimental design to study the fluid-sediment interactions; (2) the experimental setup, post-processing statistics and visualization, and preliminary results of the initial phase of this work; and (3) the experimental methods underway for the latter phase of this work.

Currently, the presenters are in the initial phase of the project which involves quantifying the turbulent structure of the flow using highly sensitive velocimetry techniques. Instrumentation is setup and calibrated including instrumentation for intrusive measurements and non-intrusive measurements of instantaneous velocity. Thereafter, statistical and visualization techniques are used to assess fluid structure. The methods are able to capture the dominant eddy processes which act to dislodge sediments and transport the material downstream. Results are preliminary at this time, however, the results are expected to provide data regarding the fluid forces which may dislodge sediment particles.

The presenters also discuss the latter phase of the project which involves introducing upland sediment supply at the entrance to the flume and monitoring the impacts upon fluid turbulence and cohesive bank material placed in the fully developed region within the flume. Sediment parameters in phase of the study are being designed based on field

measurements and published data in the region of Central Kentucky. Based on the data found in the field, a set of experiments will be designed and scaled to constitute the range of sediment parameters found in the field. A number of parameters will be held constant for the experiments such as water chemistry and microbial content within the cohesive material.

This research is expected to provide a better understanding of the importance of upland sediment supply upon streambank erosion, specifically for flow and sediment conditions typical of Kentucky watersheds. The significance of this study is that it may provide relationships which will be incorporated into stream erosion models for predicting sediment flux in basins of this region. Thereafter, better optimization of upland and streambank conservation practices may be achieved at the watershed scale.

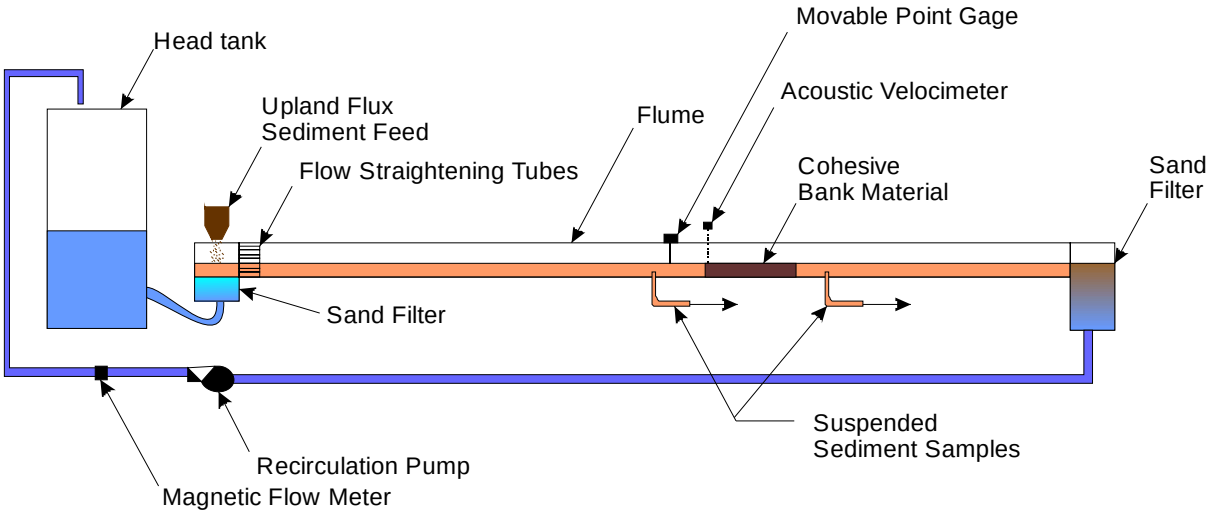

Figure 1. Recirculating flume to measure fluid-sediment interactions.

BIOLUMINESCENT AND CHEMILUMINESCENT WHOLE CELL SENSING SYSTEMS FOR THE DETECTION OF HYDROXYLATED/DIHYDROXYLATED POLYCHLORINATED BIPHENYLS

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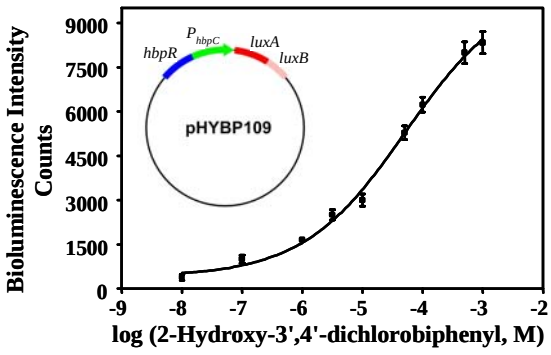
Polychlorinated biphenyls (PCBs) were mainly used as dielectric fluids and flame retardants in the industry. Release of PCBs into the environment has caused global burden due to their persistent nature and tendency to bioaccumulate and biomagnify through the food chain. Extensive studies have focused on their environmental and biological residues, toxic effects, health impact, and environmental remediation. Increasing interest has been shown to hydroxylated/dihydroxylated PCBs, as the main products in PCBs biodegradation pathway. Their estrogenic and thyroid-hormone-like activity in animal models, along with their potential health threat to humans are main concerns to scientists. Recently, several studies identified PCB metabolites in water bodies, animal tissues, and human serum, plasma and whole blood. The ubiquitous presence of PCB metabolites in environmental and biological samples dictates the need for a method able to rapidly detect these toxins. Standard analytical methods such as gas chromatography are not cost-effective, are time consuming, and require technical expertise. Thus, a simpler and faster screening method is needed. As a fast growing technology, various whole cell sensing systems were developed to estimate different kinds of pollutants. A whole cell sensing system is based on genetically modified cells constructed in such a way that, in the presence of a target analyte, the bacterial cells express a regulatory protein along with a reporter protein. Consequently, the concentration of the inducer analyte can be quantified by measuring the signal generated by the reporter protein. We demonstrated the development of such whole cell biosensors by employing two different reporter genes, namely the bioluminescence gene *luxAB* and the chemiluminescence gene *lacZ*, fused to the *hbpR* and *clcR* genes encoding the regulatory proteins of the hydroxyl-PCBs and dihydroxy-PCBs systems, respectively. Under predetermined environmental conditions, the detection limits of hydroxylated PCBs are in the range of 10^{-4} to 10^{-9} M. The potential of using a whole cell sensing system to detect hydroxyl-PCBs in human serum samples was demonstrated by selecting 2-hydroxy-3,4-dichlorobiphenyl as a model toxin. The validity of the assay in the detection of hydroxyl-PCBs in biological fluids was demonstrated by analysis of these compounds in serum samples.



NOTES

THE KENTUCKY WATERSHED MODELING INFORMATION PORTAL (KWMIP): KWMIP DATASET AND MODEL SUITES AND COMMONALITIES

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In September, 2004, The Kentucky Commonwealth Office of Technology (COT) was awarded $750,000 from the US Environmental Protection Agency (USEPA)'s Environmental Information Exchange Network (EIEN) to develop the Kentucky Watershed Modeling Information Portal (KWMIP). This 2-year project will develop a web-based portal to quickly and accurately deliver current and appropriately formatted watershed model input data for selected models (Schaffer et al., 2006).

In order to design KWMIP to address the needs of future portal users, a Technical Advisory Group (TAG), consisting of future portal users and experts from agencies, academia, non-profits and consultants, is advising the Project Partners. The TAG will provide input regarding model selection and key model input datasets, identification of portal functions and training needs. Over 80 individuals were invited to participate on the TAG, which to-date has delivered the User Needs Analysis, the Data Matrix (DM), and the Use Case documents.

A TAG Subcommittee, the DM Working Group, summarized data needs for a short list of nine models (LSPC, EFDC, QUAL2K, HEC, SWMM, Load Duration Curves (LDC), HSPF, ModFlow (MODFLOW), and WASP)) and explored the capabilities of two tools (BASINS and WCS). Over 80 sources of data have been identified thus far. The approximately 90 datasets identified were categorized in two ways. Depending on the existence of location (geographic) information, the datasets were classified into spatial (i.e. geographic) or tabular categories, identifying 27 and 42 datasets, respectively. Another set of categories was identified as thematic or disciplinary: Basemap (13 datasets), Climate (16 datasets), Geology (3 datasets), Hydrology (29 datasets), Source (16 datasets), and Water Quality (11 datasets). Many of the spatial data layers are

[6] With KWMIP Project Partners: Bill Caldwell, Lee Colten, Ann Fredenburg, Eric Liebenauer, Kay Harker, Peter Goodmann (KDOW), and Mark Ayers (USGS, KY Water Science Center).

anticipated to be previewed and delivered through enhancements to DGI's existing web services (i.e. KYGeonet at: http://kygeonet.ky.gov).

Information compiled and conflated in the DM was utilized in producing a list of minimal datasets or models for KWMIP to support. The DM datasets were organized by model and are summarized on Table 1. Data suites were created to extract commonalities inherent in given model suites. Some model suites potentially supported by KWMIP were stable, depending exclusively on the largest data suite, which in this case is suite *1*, containing the largest number of datasets. Data suite *1* satisfied the data requirements for LSPC, LDC, HSPF and MODFLOW models. Adding data suites *2* and *3* sequentially would support EFDC, QUAL2K and WASP models. Only by adding data suites *4* and *5* would HEC and SWMM models be fully supported by KWMIP.

The KWMIP model selection process is ongoing. Further refinement and prioritization of datasets is planned in the very short term, leading to a reconfiguration of the data and model suites presented here.

Data Suite		***LSPC***	***EFDC***	***QUAL2K***	***HEC***	***SWMM***	***LDC***	***HSPF***	***MODFLOW***	***WASP***
1		50	41	14	6	29	12	50	5	41
2			7		1	4				6
3				5						2
4					4	4				
5					1	3				
Datasets Needed		***50***	***48***	***19***	***12***	***40***	***12***	***50***	***5***	***49***
Data Suite Combination	*1*	100%	85%	74%	50%	73%	100%	100%	100%	84%
	1+2	100%	100%	74%	58%	83%	100%	100%	100%	96%
	1+3	100%	85%	100%	50%	73%	100%	100%	100%	88%
	1+2+3	100%	100%	100%	58%	83%	100%	100%	100%	100%
	1+2+4+5	100%	100%	74%	100%	100%	100%	100%	100%	96%
	1+4+5	100%	85%	74%	92%	90%	100%	100%	100%	84%

Table 1. Total and partial dataset requirements for supporting specific KWMIP models and model suite commonalities.

References

Schaffer, K.L., K. R. Odom, S. A. Bacharach, and G. H. Harp. 2006. The Kentucky Watershed Modeling Information Portal's User Needs Assessment, Data matrix and Use Case. 2006 WRRI Symposium Proceedings.

Occurrence and Distribution of Mercury in Mammoth Cave National Park

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The fate and transport of mercury in Mammoth Cave National Park (MCNP) will be examined in order to determine mercury's mobility in surface and ground water. Mercury (Hg) is a persistent neurotoxin that is easily transported through karst aquifer systems; for example, the South Central Kentucky Karst (SCKK) ecosystem, which includes the MCNP area. The largest source of mercury to MCNP is atmospheric deposition, largely produced by coal-fired power plants. Hg from the atmosphere deposits in rivers, sediments, and organisms through rain, wind, and bioaccumulation.

The current data shows a potential threat of Hg levels in the drinking water and Hg bioaccumulation in a number of surface and subsurface organisms of MCNP. Background levels of mercury, 0-25 ppt in the water and 0-3000 ppb in the sediment have been observed. A number of surface and subsurface organisms are endangered or declining in MCNP due to bioaccumulation of mercury. Observed levels of mercury in fish and clam samples are comparable to values observed in other studies (0-0.50 ppm). Mercury levels in different bat species, including federally listed endangered species in the park have been examined which show 1-9 ppm. Quality analysis and quality control tests were done using a human hair reference material as a standard. Mercury concentrations in bats collected at various locations during summer 2004 and summer 2005 and hair from archival bats were analyzed and compared in order to investigate the potential for mercury bioaccumulation.

NOTES

REPROJECTING THE *KLS* (KENTUCKY LANDSCAPE SNAPSHOT PROJECT) IMPERVIOUSNESS LAYER: THE EFFECTS OF RESAMPLING METHOD ON IMPERVIOUS CLASS DISTRIBUTION IN SELECTED URBAN AREAS

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The 2001 30-m imperviousness layer is published and originally available for downloading from both the USGS Seamless Data Distribution Center at: http://seamless.usgs.gov/website/seamless/viewer.php. Cubic convolution interpolation was used to re-project the data from USGS Albers Equal Area to Kentucky Single Zone projection (SPCS, FIPS 1600), which were then clipped to the buffered state boundary and then published also on the KY Geonet at: http://kygeonet.ky.gov).

Imperviousness is an important hydrologic variable, which reflects multiple land cover and land use modifying processes and is utilized in several hydrologic models. Urban areas in Kentucky were "sampled"; the urban – corporate – boundaries for 8 urban cities were selected: Bowling Green, Maysville, Middlesboro, Owensboro, Paducah, Pikeville, and Williamstown-Dry Ridge were selected (Anness, 2006).

The nearest neighbor interpolation method not being suitable for quantitative data, three different methods of interpolation were assessed: bilinear (BLI), cubic convolution (CC) and bicubic spline interpolation (BSI). These methods become more computationally intense, resulting – purportedly - in increasing quality as one progresses from BLI to BSI.

The results are characterized in two different ways: spatial distribution of imperviousness values (Figure 1), and overall frequency distributions by imperviousness numerical class (Figure 2). As compared with the original data, contrast is lost by using BLI, while the CC and BSI methods preserve the general geometry and crispness of the impervious area distribution (Figs. 1 (a), 1(b)). The BSI method created artifact pixels with imperviousness>100% (Figs. 1(a), 1(c)), indicated in black on the figure.

The frequency distribution for the 100 classes of imperviousness was better preserved by the CC method versus the BLI and BSI methods, with respect to the original data (Figs. 2(a), 2(b), 2(c)).

References

Anness, Kimberly. 2006. Corporate boundaries geodatabase maintained and filed with the Kentucky Secretary of State, and published to the KYGeonet (http://kygeonet.ky.gov).

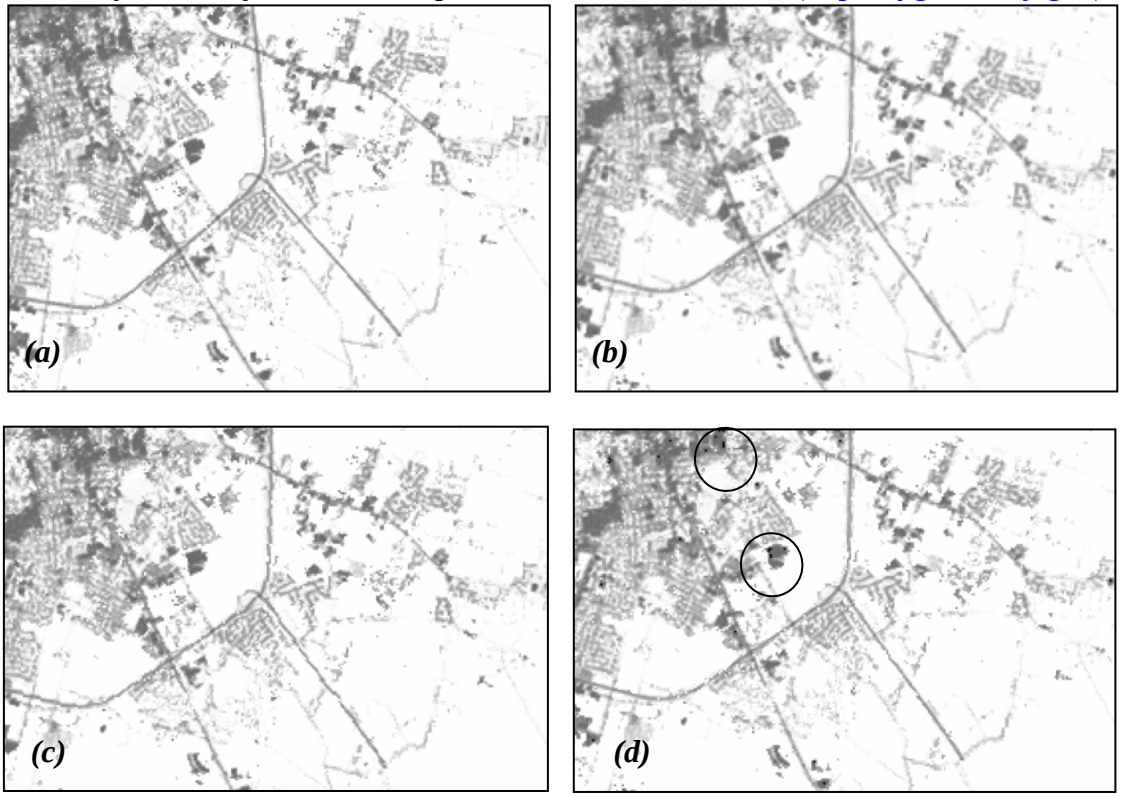

Figure 1. Results from re-projection with different interpolation methods. (a) original imperviousness (USGS – Albers Equal Area); (b) bilinear interpolation (FIPS 1600- KY Single Zone); (c) cubic convolution (FIPS 1600); (d) bicubic spline (FIPS 1600) – pixels with over 100% imperviousness values indicated inside circles. (*Scale*: approx. 1:40,000; Owensboro vicinity).

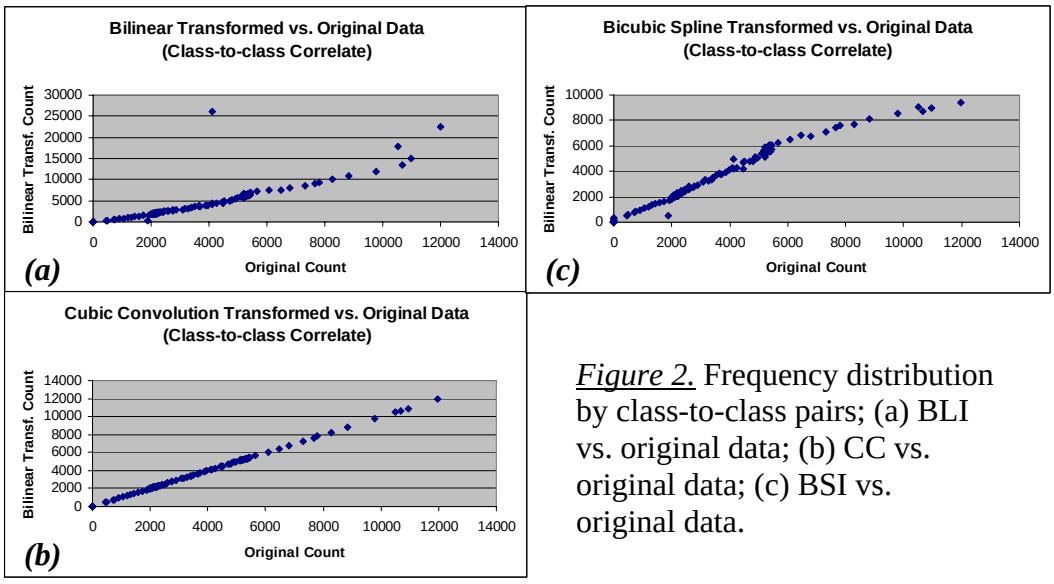

Figure 2. Frequency distribution by class-to-class pairs; (a) BLI vs. original data; (b) CC vs. original data; (c) BSI vs. original data.

AN ASSESSMENT OF "HOT SPOTS" & PIRORITY WATERSHEDS FOR CONSERVATION OF IMPERILED FRESHWATER MUSSELS AND FISHES IN KENTUCKY

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Kentucky's native freshwater fish and mussel faunas are among the richest in North America, the center of worldwide freshwater mussel and temperate freshwater fish biodiversity. Mussels and fishes are among the most imperiled taxonomic groups nationally; their distribution in Kentucky is well documented. During the last century, habitat destruction and degradation (e.g., dams, pollution) caused the extirpation or extinction of 21% and 4% of Kentucky's mussel and fish taxa, respectively. Of the extant taxa, 41% of mussels and 25% of fishes are imperiled because of significant declines in diversity, numbers and distribution. Although there are efforts to conserve imperiled aquatic taxa priority areas for conservation have not been assessed. Priority areas must be identified so limited conservation funds can be expended wisely.

The objective of this analysis was to identify hot spots, watersheds with the highest species richness, and priority watersheds for conservation of extant imperiled freshwater mussels and fishes in Kentucky. Using Geographic Information Systems each of 616 Kentucky watersheds (11-digit U.S. Geological Survey hydrologic unit codes) were scored for post-1984 records of imperiled mussels (33 taxa) and fishes (50 taxa) in the KSNPC Natural Heritage Program database. Only 31% of the 616 11-digit watersheds in Kentucky had at least one imperiled taxon and only 1.9% were determined to be hot spot watersheds (a watershed that supports 8 or more imperiled taxa). Using a rarity-weighted richness index (RWRI) 53 watersheds were identified as priority watersheds, an area totaling ca. 1,490,896 hectares or 14% of Kentucky. This preliminary assessment focused on imperiled mussels and fishes. A future assessment will use data for all native mussel and fish taxa to determine priorities for biodiversity conservation of these groups.

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